WILSON ORNITHOLOGICAL CLUB

The American Biology Teacher

VOL. 2 JANUARY, 1940 NO. 4

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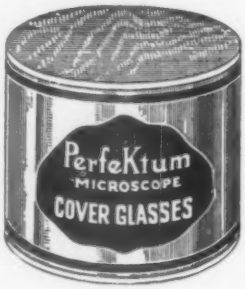
PUBLISHED BY
The National Association of Biology Teachers



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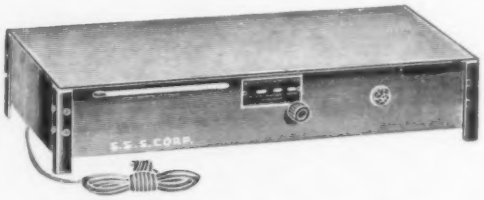

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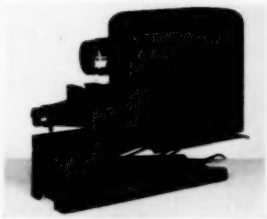

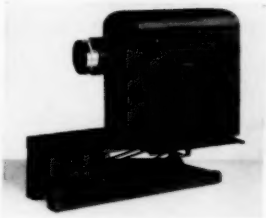

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THE AMERICAN BIOLOGY TEACHER

Publication of The National Association of Biology Teachers.

Issued monthly eight times during the school year from October to May.

Publication Office—N. Queen St. and McGovern Ave., Lancaster, Pennsylvania.

Correspondence concerning manuscripts may be addressed to any of the Associate editors or directly to the editor-in-chief.

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Entered as second-class matter October 26, 1938, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

The American Biology Teacher

Vol. 2 JANUARY, 1940 No. 4

An Introductory Series of Problems in Practical Bacteriology for the High School Biology Course

B. BERNARR VANCE

Daniel Kiser High School, Dayton, Ohio

The following three problems are intended to introduce the pupil to elementary routine work in bacteriology and to suggest some of the basic techniques employed. We use them as special group exercises for pupils in College Prep or Pre-nursing courses, and for others working beyond the minimum requirements of the course of study for tenth year biology. These problems require simple apparatus and materials, and can be completed with a minimum amount of teacher direction.

PROBLEM 1. To prepare a standard culture medium for growing bacteria.

Instructor's OK ——

Materials: Beef extract or bouillon cubes; agar-agar or flake gelatin; balances; beaker or small cooking vessel; roll cotton; test tubes; steam pressure cooker; sterilizer, autoclave, or large vessel for boiling water; flask or bottle; glass funnel; rubber tubing; pinch clamp; burner; test tube rack; distilled water.

Method: Measure out 100 cc. of clear or distilled water into a beaker or small cooking vessel, and add ½ g. of beef extract or bouillon cube. Mark on the side of the vessel the level of the contents. Heat until all solid materials are dissolved. Add to this beef broth 1½ g. of agar-agar (flake gelatin may be substituted). Boil until dissolved, adding enough water to replace that boiled away. Line the funnel with a layer of cotton, and filter the solution into a flask or bottle.

Now rinse the funnel and fit it with a short length of rubber tubing and a pinch clamp. Pour the hot solution back into the funnel, and draw off into test tubes enough to fill each tube about ¼

full. Roll cotton plugs, fitting them into the tubes to a depth of about ¾ in.

Put the prepared tubes in a steam pressure cooker, sterilizer, or autoclave for about ½ hr. at about 15 lbs. pressure, or boil in water for an hour, to kill all bacteria. Take out, tilt one tube against a book or other support to make an "agar slant" tube, and set the remainder upright in the rack to cool. Store in a dry place.

To make larger quantities of the medium, use proportionately larger amounts of all materials.

Submit the culture tubes to the instructor for criticism. Be prepared to answer the following questions:

1. What purpose does beef extract serve in the culture medium? The agar-agar?

2. What is the source of agar-agar? State another commercial use of agar-agar.

3. Why are cotton plugs used in the culture tubes instead of cork stoppers?

4. How does steam under pressure kill bacteria more effectively than boiling water?

PROBLEM 2. To grow and transfer bacteria. Instructor's OK ——

Materials: Culture tubes prepared in preceding exercise; 5 petri dishes; straight inoculating needle; burner; vessel for boiling water; glass plate; incubator or darkened box equipped with light bulb or other warming device; wax pencil; gentian violet stain or ink; slide; microscope; glass rod.

Method: Sterilize 5 petri dishes in a hot dry oven for three hours. Set the upright tubes of culture medium from the preceding exercise in a vessel of hot water until contents are melted. Taking one of the tubes between two fingers of one hand, remove the cotton plug with the other hand. Hold the neck of the tube in a hot flame for a few seconds. Using the hand holding the cotton plug, raise the lid of a sterile petri dish enough to admit the lip of the tube and pour the melted medium into the dish. Allow the lid to drop back into place immediately. Repeat for each of the other petri dishes. Mark the dishes A, B, C, D, and E respectively, and set them aside on a glass plate to cool.

When they are cool, carry Dish A outdoors, remove the lid entirely and expose it to the air for five seconds; replace the lid. Expose Dish B in the same manner in the school hallway while classes are passing. Raise the lid of Dish C slightly at one side and allow a fly or other insect to walk across the surface of the medium. Rub the finger tips across a dusty table top or window sill and press against the surface of the medium in Dish D. Catch a drop of drinking water on a glass rod. Introduce into Dish E, allowing the drop to run across the surface of the medium. If you are unable to expose dishes exactly as directed above, work out similar exposures for yourself, and note any changes made in the directions.

Place all dishes *upside down* in an incubator at a temperature between 30 and 35 degrees Centigrade (86 to 95 degrees Fahrenheit), or in a darkened box equipped with a light bulb or other warming device, for about three days. Take out and examine carefully. Note general observations of respective dishes.

Different kinds of bacteria can be roughly distinguished by color and manner of branching over the surface of the medium. Select and mark one of the more interesting colonies. Clean a microscope slide, place a small drop of water on it, and set it aside on the table. Holding the handle of the inoculating

needle with one hand, thrust the needle into a hot flame until it glows along its entire length. This is called "flaming" the needle. Cool quickly in the air, raise the lid of the dish containing the colony selected, and touch the needle to the surface of the colony. Remove and wash the needle tip back and forth in the drop of water on the slide until the bit of colony is distributed throughout the water. Again "flame" the needle and lay it aside on the table.

Hold the slide well above the flame until all the water evaporates, leaving the bacteria fixed to the surface. Cover this area with ink or gentian violet stain and allow to stand for three minutes. Wash off all extra stain, dry over the flame, and place under the highest power of the microscope. No cover glass is needed. Use the oil immersion lens, if available. Consult the instructor if you have not previously used this lens. Focus carefully, using as little light as possible. Observe individual bacteria. What shape are they?

Now take an agar slant tube between two fingers of one hand. Take up the inoculating needle with the other hand and flame it. Using the hand holding the needle, remove the cotton plug from the tube, grasping it between two other fingers. Bring the neck of the tube into the hot flame for a few seconds, and again touch the tip of the needle to the original colony in the petri dish. Insert the needle to the bottom of the culture tube, dragging the tip over the surface of the culture medium as it is removed. Be careful not to break or scratch the surface of the medium with the needle or to touch the sides of the culture tube. Again heat the neck of the tube and replace the cotton plug.

Incubate for three days. Remove from incubator, and carefully examine the colonies in both tubes comparing their spread and color with the original colony in the petri dish. Remove a bit of the colony from one tube to a microscope slide, stain, and observe under the microscope as before.

Be prepared to answer the following questions:

1. An isolated colony growing in a petri dish is usually considered a pure culture of bacteria. Why?

2. Are more bacteria present in outdoor air than in the air of a crowded hallway? Why should this be true?

3. What may be a reason for heating the neck of the culture tube as the cotton plug is withdrawn or replaced?

4. What advantage for growing bacteria does the agar slant tube have over a "stab" tube (here the medium is allowed to harden as the tube stands in an upright position)?

5. What qualities should the metal of an inoculating needle possess?

PROBLEM 3. To count the bacteria in milk. Instructor's OK ——

Materials: Four sterile petri dishes; 1 cc. and 10 cc. pipettes (these may be made up from measured and marked lengths of glass tubing); reading glass or hand lens; wax pencil; three wide-mouthed bottles; sample of fresh milk; four tubes of agar-agar culture medium; glass plate; graduated cylinder.

Method: Measure 99 cc. of distilled water into each of two wide-mouthed bottles, marked A and B respectively, with the wax pencil. Put 90 cc. of water into a third bottle marked C. Plug all with loosely-rolled cotton. Sterilize as for culture media in the preceding exercise. Sterilize the petri dishes and pipettes in a dry oven for several hours.

Secure a fresh sample of milk, shake

it well, and pipette 1 cc. into bottle A. Shake this mixture thoroughly, and then pipette 1 cc. of it into bottle B. (Use a fresh sterilized pipette for each separate transfer.) Bottle B now contains a 1/10,000 dilution of the original milk sample. Now pipette 10 cc. of the solution in bottle A into bottle C. Bottle C now contains a 1/1000 dilution of the original sample. After shaking it thoroughly, carefully transfer 1 cc. of the solution in bottle C into each of the two sterile petri dishes, introducing only the tip of the pipette into the dish by raising the lid slightly at one side. Mark these dishes No. 1 and No. 2 respectively. Now pipette 1 cc. from bottle B into each of two sterile petri dishes, in the same manner. Mark No. 3 and No. 4 respectively.

Melt the sterile culture medium by placing the tube in hot water. Cool slightly, and pour the contents of one tube into petri dish No. 1, raising the lid carefully at one side only enough to allow the liquid to be poured. Repeat for the remaining three dishes. Rotate each dish several times to distribute the culture medium evenly, and set aside on a glass plate to harden. Mark the bottom of each dish with the dilution figure, date, a mark to identify the milk sample, and your initials. Invert the dishes in an incubator or warm chamber at a temperature of 30 to 35 degrees Centigrade for three days. (The dishes may be placed in a warm dark room, if an incubator is not available, or a light bulb may be hung in a box and the temperature checked over a period. Different sizes of bulbs may be used to secure the temperature desired.)

After three days remove from the incubator, and with the wax pencil mark off the bottom of each dish into eight equal sectors. Holding each dish against a dark surface and using the magnifier, count the number of colonies growing on the surface of the culture medium. Ask the instructor to help you distinguish bacteria colonies from flecks of mineral or impurities in the culture medium. It is supposed that each colony started from a single bacterium. Hence, the number of colonies in one dish, multiplied by the dilution figure, represent the approximate number of bacteria in 1 cc. of the original milk sample. Too many colonies may be present in dishes No. 1 and No. 2 for accurate counting. If so, these two may be disregarded. However, all four dishes should be counted if possible, and the results from all four averaged to secure the count for final report.

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Willis W. Collins
Idabel, Oklahoma

The Science Teacher Orders His Films

BERNARD LEIBSON
Christopher Columbus H. S., New York City

It may be sacrilege—but it is nevertheless true—to say that there is among many teachers of science a waning of enthusiasm for the use of films in their classrooms. Film sales, in all probability, have in no way been affected; the validity of a visual instruction program has not been questioned.

Teacher dissatisfaction, of course, may arise from a variety of causes. It may be due to such external factors as difficulty in obtaining films or disruption of classroom routine when films are used. It may be occasioned by a lack of coordination between film and course of study or by pressure of overcrowded syllabi. Where rigid, uniform examination systems are in vogue, teachers may find films of little "value."

There is, however, something more basic to the dissatisfaction (a dissatisfaction, incidentally, that has also been expressed by students objective enough about study to overcome their enthusiasm for "movies"). The failure to make satisfactory use of so valuable an instrument of instruction has not been due to administrative details or even to faulty teaching technique. It has been due, rather, to a serious pedagogical flaw in the production of educational films.

There are several misconceptions which are affecting the production of pedagogical films. First of these is the belief (it may be a financial dictate) that one film on a subject can serve all the possible functions of an instrument of visual instruction. Second is a notion readily accepted by companies and some teachers that a visual instruction program with the use of films is a pedagogical panacea. Exposure to adequate doses of V.I. was, and still is, believed to eliminate learning difficulties forthwith.

The third and most serious misconception is the belief that a film can and should replace the teacher. If only for brief periods, certain areas of learning could be wholly "imparted" to large groups of students without benefit of pedagogue. Administrators found in this conception of the use of films a "solution" for the many problems arising from the overcrowded building; teachers found in it an occasional much needed rest period; companies producing these films saw its possibilities.

These three ideas have led to the organization of educational films on the artistic-whole-complete-in-one basis. Originating in the "short-subject" film of the motion picture industry and subject, at least psychologically, to the dictates of the Hollywood masters, the educational film became the "complete presentation," however elementary. There was an implication that the film was a complete entity and, with the advent of sound, a complete "lesson" was made possible without much assistance from the teacher.

That this "service" failed to materialize is of secondary importance. What is of moment is that the misconceptions

mentioned persist and that because of them films are being produced that fail of their purpose in certain phases of a visual instruction program.

The belief that one film can serve all functions has led to the making of films that serve none. Where arousing interest or inculcating attitudes is the aim of the film the "artistic-whole" or "short-subject" technique is most valuable and let there be no mistake, this type of film is of vital importance. But there are direct instructional phases of a visual instruction program where this technique may be extremely harmful. A complete dependence on this technique produces films that are hodge-podges from an instructional point of view. In films for this purpose, emphasis on dramatic unity and coherence brings about excess treatment of subject matter that needs little visual "treatment" while it neglects to give sufficient treatment of those phases that need it most. In this way, a valuable function of films is being ignored and it is with this function—not those of arousing interest, training in attitudes, giving over-views, or presenting problems—that we are concerned here.

The panacea and teacher-substitute conceptions of visual instruction are, of course, open to criticism from many angles, but what is important here is to substitute the proper conception of the place of photography in a plan of instruction. It should be considered as part and parcel of the established principle in education that we learn by experiencing. Direct, first-hand experience with a place, a process or a phenomenon is most satisfactory. If this first-hand experience is impossible, secondary experience—photography—is next best. Both types are preferable to verbal explanation where children without a background of first or second hand experience cannot translate the verbalizations into concepts. In the last twenty-five years, films have become an additional and more effective means of putting into practice this principle of learning by experiencing where—and especially where—the possibility of direct experience is of necessity remote from the classroom. Outside of its possible functions of arousing interest, providing an overview, or presenting problems, the film is a pedagogical instrument for providing secondary experiences in much the same way that microscopes or experiments are means for providing direct experiences.

There is no doubt that film producers and teachers have realized the immense possibilities for providing experiences not otherwise obtainable but there has been no full exploitation of this realization. This is the crux of the failure.

Based on the previously mentioned misconceptions and inspired by the "short-subject" technique, films have not contributed their fullest to those phases of instruction where they are in reality the only proper means of learning. Where first hand experiences are available films are of little value. Why use a secondary experience when first-hand ones are obtainable? Other secondary experiences, like a still photograph, may even be more valuable for close study as well as more practicable for efficient classroom use than a "moving picture" of the same object. There is nothing inherently valuable in a motion picture. It must not trespass upon the field of other experience-providing devices because (1) there is great value in those other devices, and (2) especially because there is so much for the film to do in its own particular field where there is nothing that can compare with it in effectiveness.

A case in point. There is a widely used film (considered "pretty good" by most biology teachers) that attempts to trace the development of the fruit from its beginnings in the flower. This film is of considerable help in the learning process because it does provide experiences that cannot well be given in any other way to students of city high schools. However, laboring under the short-subject-logical-whole psychology the makers of this film have made it practically impossible, even with varied teaching techniques, to get over the maximum number of needed experiences that a motion picture on this subject could provide. Pedagogically there are phases of this topic that are of considerable difficulty for the teacher since direct experiences are not available. The teacher is, in these cases, completely dependent upon the motion picture, but as has been indicated, these particular phases do not get adequate treatment. Phases that can easily be covered by other devices—especially direct experiences—receive as much treatment, if not more. The pedagogic inefficiency of such an arrangement should be evident.

The entire plan of the film is a product of the short-subject idea rather than of the experience-providing principle. Who, in a high school classroom, can cover the development of bud to fruit in twenty minutes, or with the "interrupted film technique" who can do it in one period? The result has been that the film has come to be used as a summary film to review concepts taught otherwise. The film has also been used to introduce the topic but for this purpose it has been found entirely too crowded with concepts. These are perfectly admissible functions of a film but surely they are secondary compared with the use of films as means for providing experiences unobtainable elsewhere.

It might be argued that if it is possible to spread a twenty minute film over a full forty minute period, with the proper instructional technique it might be possible to extend it over the number of periods considered pedagogically adequate for teaching the topic. But, in the film under consideration as in all others of its kind, the short-subject psychology that dictated the scenario made it necessary, first, to include experiences that are better provided by other methods and secondly, to give such fleeting glances to experiences duly within the motion picture's scope that it becomes highly inefficient to set up the film for such short phases. This is not of small moment; efficiency in the modern crowded classroom is an essential. Besides, when the phases are so inadequately treated, it becomes necessary to repeat. Too much repetition of a part or the whole of a film produces a lag in interest and enthusiasm. When the phases are particularly short as they must be in the films conceived in the short-subject vein, the repetition is deadly, as well as highly inconvenient.

To illustrate: The film under consideration opens with a lengthy showing of the essential organs of several flowers. In the logic of the "complete-whole" film, this is quite satisfactory, but pedagogically there is at least this major criticism. Parts of the flower are much better studied from direct experiences and most schools—even city schools—provide these experiences. Certainly, the smaller rural schools have no difficulty in obtaining flowers.

Of course, it is quite conceivable that the intention was to give examples of flowers not likely to have been studied or to review what had already been learned. These aims are quite defensi-

ble. In fact it might be possible to make a short film on the essential parts of several different types of flowers, but here, the difficulty lies in the fact that there is so much to the topic of development of the fruit which the film undertakes that by putting in "extra" views of material easily shown by other and better means, the film must and does fail to do justice to those experiences for which we are so dependent upon the motion picture device.

Pollination, certain phases of which need the motion picture, is dealt with hastily. No indication of wind pollination is given when it would be perfectly possible to show the collection of pollen in "traps." The demonstration of pollination by hand is rapid; students without previous experience fail to understand the quick actions. It seems that the plan "to cover" the topic made for brevity even though vital experiences not easily obtainable otherwise might be omitted. The only item given sufficient attention is insect pollination and this, no doubt, is one of the facts that makes the film of some value.

There follows a good microscopic view of pollen grains but the view of pollen tubes and the sperm nucleus is hurried. Most schools are in great need of just these hurried views since many of them have few microscopes and high school laboratories are not always successful in growing pollen tubes while the few that do rarely show the sperm nucleus. Actual experience with the film has shown that even when students have been taught by means of chalk diagrams about the growth of the pollen tube before the showing of the film, they fail to grasp the meaning of the microphotographs, so fast do they pass before their eyes. They must be run again and again. But in this case, the film cannot be run back with the illumination on since the tubes "grow" shorter. The result is that time is wasted in running it back blindly and estimating the time to start forward. There is an unpleasant break and a consequent let down in in interest, not to mention the inability of so short a showing to hold interest in the first place. With the proper philosophy in film production, there should be no need for awkwardness in running or for lack of interest.

The growth of the pollen tube and the travelling of the sperm nucleus are realms of experience that must be made much of. After a series of microscopic views of different pollen grains, a diagrammatic view of a pollen grain growing is needed. This should be followed, if possible, by a single pollen grain actually growing its tube. The view of many grains growing tubes simultaneously should be followed by the sperm nucleus travelling down the tube. Repetition of a still of the sperm within the tube (much better than cutting off the illumination sufficiently to stop the film) should then be shown to "clinch" the concept.

Similar criticism and recommendations apply to the next sequence in the film. The growth of the pollen tube within the pistil and the process of fertilization are phases of this topic that make a film so valuable. To rush through the process is to fail to take advantage of the contribution that the motion picture can make toward the learning process.

But the most significant failure lies in what follows in this film. While students who come from farming communities have seen the development of a part of the flower into the fruit, few city children have experienced it. Every biology teacher knows that this concept is most difficult to establish. There is a world of pedagogic difference between the

static chalk diagram and the "living" device of time-lapse photography. But no! The film again rushes on. The petals fall and presto! the fruit. A long close up of a gorgeous apple follows. Beautifully ended but pedagogically of little value. Children in communities that can afford motion picture machines have seen apples or can be shown one if needed. But how, unless by motion picture device, can most children experience the development of that fruit?

This rather extended criticism of one film was undertaken to illustrate where films are failing to perform a necessary function in classroom teaching. Illustrations could, unfortunately, be repeated from numberless films that continue to be made under the short-subject-complete-in-one-performance psychology.

Mention, however, should be made of a type of film sequence which also disregards the fact that the film should specialize in those phases of a topic toward which they can make the greatest contribution. This is the type of film that spends a good deal of time on simple experiments that can easily be done in any classroom. The experiment is, of all things, material for direct experience. Ideally, each student should perform it; the teacher demonstration is about as near to his ideal as present school organization permits us to come. Putting it in a film cannot be condoned by claiming that the schools cannot afford the materials needed for the experiment. They can afford the simple materials long before they can buy motion picture equipment. If films are made of simple experiments to save the teacher's time, the practice is vicious. A teacher that does not make use of the inspiring device—classroom experiment—had better be denied the use of films since he will most likely use it as a work saver rather than as a pedagogical device. If the experiments are put in the film to "round out" the "story," the makers are laboring under the misconceptions previously discussed. There is no reason why films and actual experiments cannot be used together, or why an experiment previously performed cannot be recalled by, or in connection with, an experience provided by a film.

When such simple experiments are included they naturally take time from other experiences. One more illustration: A film in common use shows a simple experiment on digestion that any teacher can perform, but gives a hurried view of peristalsis. It is safe to say that no high school in the United States has the means of demonstrating peristalsis. They must depend upon the film. Yet the possibilities are hardly touched, so much time is spent on the experiment.

There is no attempt here to deny that there is room for moving pictures on certain types of experiments. Those with expensive apparatus or experiments on diets which take several months and therefore are not very well adapted for performance in city schools are fit material for motion picture treatment. In such pictures, too, the Hollywood technique is not necessarily sound. Scenarios on lengthy experiments should follow the steps that would have been used had the class been able to perform it. Definite stopping places must be provided for classroom discussion on the progress of the experiment and particularly for "planning" the next step—which the film proceeds to show. Again the technique indicated here is that of using the film where direct experiences are not available but, also, of using it in such a manner that it is the next best thing to such experiences.

The fundamental bases for dissatisfaction and some suggestions for improvement have been indicated. By way of summary, it may be said that the science teacher is calling for:

1. Films that treat very short areas of experience.
   (Incidentally there is nothing sacred about the 400-foot film. Two hundred feet may be better.)
2. Films that give adequate treatment to such short areas.
3. Films that specialize in areas of experience that cannot be more successfully taught by other devices at the command of the teacher.
4. And films that take into consideration the fact that the teacher is capable of providing direct experiences and that he expects all devices to supplement and complement each other.

There remains the possible objection to the criticism made throughout this discussion of the "artistically rounded out" film. Should, then, the film of pedagogic worth lack the artistry of composition? The simple point of the matter is that the art of the short-subject-lecture film is not necessarily the art of the pedagogically sound film and, what is more important, is that the art of the short-subject film is not the art of the pedagogically sound lesson. The type of film that has been called for does not require complete artistic composition in the Hollywood sense. It is, rather, that type of film that will provide an adequate experience in a limited field just as a microscope demonstration gives an experience. There will be art in the preparation of the microscopic slide (*cf.* photography in films), but the demonstration is not the "completely-rounded-out" lesson. It is only PART of the artistic lesson; it is the experience-providing device. Introduction, body, conclusion,—the unity and coherence of an artistic lesson are not supplied by the experience-providing device. The device can and must contribute to the artistry of the lesson, but it dare not disturb it by an artistry of its own which so often is pedagogically antagonistic.

* * *

Then there is the question of who shall write the scenarios for the films of the type indicated. Of course, there need be no limitations, but it is very important that classroom teachers supply those scenarios that will fit in with the art of their lessons. There is probably something terrifying about the word "scenario" since it brings to mind that select, much heralded group of Hollywood artists. But it is just these artists or their imitators who have made no contribution to the pedagogy of the classroom. The classroom teacher who has no fear of ordering his microscope demonstrations, charts, experimental setups and the like, should have no fear of ordering films to fit in with the art of his teaching.

Such an order follows herewith. For years biology teachers have been teaching high school students the steps in mitotic cell division. For years they have relied on static illustrations to describe a process. An experience that has been extremely difficult to provide has been neglected by the only medium that is capable of providing it satisfactorily.

The following plan for a teaching film seeks to provide the necessary experience for the teaching of mitosis. It is neither a novel nor an original scenario. Its value pedagogically would lie in what it omits and in the possibilities it provides for student participation. The fact that it would become an experience-providing device rather than the "teacher" is most significant.

MITOSIS IN THE LIVING CELL

View

1. A living cell.
2. Stained cell—the same to be used throughout the film.
3. Diagram of cell with labels of essentials only—the same to be used throughout the film.
4. Formation of the twisted threads of chromatin matter.
   a. A view of the living cell actually going through this process would be best.
   b. An animated diagram would be second best.
   c. If the living cell in process is not very clear but shows some changes, it might be used and followed by the animated diagram.
   d. A clock to show the speed of the time-lapse device should be included.
5. Stained slide showing stage at which View 4 has stopped.

* *

6. The emergence of the individual chromosomes and their splitting.
   a., b., c., d., as of View 4.
7. Stained slide showing stage at which #6 has stopped.

* *

8. The movement of the chromosomes to the "equator" of the formed spindle.
   a., b., c., d., as of View 4.
9. Stained slide of chromosomes at "equator."

* *

10. The movement of the chromosomes toward the poles.
    a., b., c., d., as of View 4.
11. Stained slide of stage where #10 stopped.
12. The reformation of the nuclei and the splitting of the cell.
    a., b., c., d., as of View 4.
13. Holding the end of View 12 or stained slide of newly split cells.

By way of explanation. The introductory scenes, #1 and #2, provide opportunity for the students to recognize parts of the cell they have presumably studied. It is quite inconceivable that mitosis should be taught without such a basis. View 3 gives opportunity for students to check their own answers.

The asterisks (* *) indicate suitable stopping places. The class summarizes verbally what has happened. With the room lights on, the last stage of each step may be drawn from memory or comparison can be made with previously prepared charts or diagrams. The students can then make the necessary distinction between static drawings and the "happenings" (*i.e.* process) depicted on the screen. Where the teacher uses microscope slides of mitosis, the film may precede or follow, but in either case pauses may be shorter since only the action would be summarized.

The significant point here is that the film will fit into a variety of lessons without breaking their continuity. It could hardly be used as the lesson itself; it simply provides an experience as directly as it is possible to do, without eliminating teacher, chart, discussion and (amazingly) the students' mind. Its omissions are important. It does not attempt to "teach" the entire problem of cell reproduction. No time is taken to give the "when" and "why" of cell reproduction. Explanation of surface problems is not made. No comparison is made with cells where mitotic figures are not clearly visible, nor is an attempt made to differentiate between the mitotic and meiotic processes. It is rather bold to say it but it might be ventured that the Hollywood, complete-in-one film would have included them all!

The scenario suggested would simply give the opportunity to students for experiencing mitosis. The art of using that experience is left to the teacher—and to the students.

THE QUESTIONNAIRE

Members of N.A.B.T. who have not yet filled in and returned the *questionnaire* sent out early in December by the Committee on the Teaching of Biology are urged to do so soon and also to ask their colleagues to do likewise. If you did not receive this questionnaire notify Dr. D. F. Miller, Biology Building, Ohio State University, Columbus, Ohio.

FINANCIAL REPORT

THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS

1938-1939

The following financial report was prepared and submitted for audit by Mr. P. K. Houdek, Secretary-Treasurer. The books of the secretary-treasurer of the national association for the year 1938–1939 have been examined by the auditing committee comprised of Grace L. Cook, chairman; Mr. Louis A. Astell; and Mr. W. V. Balduf. The books and financial report have been declared correct in every detail.

Receipts

Memberships	
1938–39	$1,607.25
1939–40	342.00
1940–41	2.00
Advertising	728.68
Miscellaneous	195.15
	$2,875.08

Expenditures

Journal	$2,246.89
Association	390.25
	$2,637.14
Returned Check	1.00
Total	$2,638.14
Balance in bank	236.94
	$2,875.08

Assets

Balance in bank	$ 236.94
Accounts due (advertising)	313.71
Supplies and equipment	35.00
Address stencils	50.00
Back Copies	50.00
Total	$ 685.65

Liabilities

Advance payments of Memberships	$ 344.00
Accounts payable	
Journal	22.25
Association	12.03
Total	$ 378.28
Credit Balance	307.37
	$ 685.65

LIFE SCIENCE AIDS

Life science teaching must become more effective and meaningful. Probably if we strive toward the latter, we shall accomplish a greater effectiveness.

We must clarify our purposes and our programs in order that they will take place in terms of a conception of education that is consonant with the times—our outlook upon life is constantly being affected by advances in science; therefore, we are constantly having to work out different methods and techniques for the attack upon our problems.

Our high schools today have changed from institutions that just train the intellectuals for leadership, to those that seek to meet the needs of all the children of all the people. In view of the marked changes in the character of our school population, preparation for college is abandoned in favor of preparation for every day living. It is the business of the teacher to understand the nature and the needs of the student in his manifold relationships, and to help him to

meet his needs in such a way as to make life ever richer.

Each activity that is undertaken by the students in order to acquire information, skills, and habits, in order to solve problems, in order to take trips more intelligently, in order to enjoy books, stories, and poems, and in order to appreciate nature, should be evaluated on the basis of its contribution to improved living. Select those that best lend themselves to your type of student body, your equipment, and your community.

Develop your program in terms of the needs and the interests of individuals and of society at large. Methods that you might use to determine the interests include those of keeping notes of classroom happenings during a semester or two, keeping a record of questions asked by students in the class, making a survey of student interests and hobbies, making a list of materials brought to school, and keeping records of conferences held with individual students.

Our rooms should give the appearance of being general work rooms, having laboratory facilities, study facilities, visual education facilities, etc. Although they are cooperative workshops they should also be made as attractive as possible. Keep the bulletin board a place of changing vital interests. Why not include different types of attractive flower decoration? When the time comes that you feel you can offer the students greater freedom than you ordinarily do, and this will vary with your different classes, try having the student president conduct a short current event discussion at the beginning of each period. We have found that this method of scoring is very satisfactory:

The president has a list of all students in the class. He assigns certain ones of them the privilege of sharing new things in the field with the others. Each event is followed by a discussion when it warrants it. The president gives a student one point if he gives his facts orally, one if he tells the source of his information, one if he selects a good life science topic, one if he tells it well and in an interesting understandable way, and one if he follows it with his reaction to his own event. This makes it possible for a student to get as many as five points for one event.

Following this plan will free you for doing first minute routine things and will get the students into the habit of expecting motors to begin turning on time.

Another aid is that of an orderly departmental or classroom file. Classify good student work so that it will be available when needed. Standardize the size of mounting board for your pictures. "Many hands make light work," they say. Why not call upon the students to bring material for the files? You might even use NYA workers to do the cutting, pasting, and filing. In building magazine files keep in mind that those like the National Geographic can be unstitched and divided into separate articles. Each can be placed within a manila cover or can be bound in your print shop. These when titled, classified and filed are most valuable.

Many of our students have a great deal of spare time, and little initiation or knowledge to plan the wise use of it. Why not interest and instruct them in taking trips, incidentally collecting life science credit? Have a suggestive list of trips posted in your room for reference purposes, giving the location, the costs involved, and the visiting hours. You might even include directions for getting these. Credit could well be granted for scientific lectures attended or listened to over the radio.

This is a copy of the blank we use,

one being filed by each student for each trip taken or lecture attended.

Student's name ..... Grade.....
Subject and period .....

Record of Scientific Visits and Lectures Attended

Place visited or lecture attended .....
Date of visit or lecture .....
Time spent there .....
Interesting discoveries:

We are anxious to have our students become more interested in reading and this is brought about by getting them to read more in books having a scientific vocabulary that they can handle, and giving them science credit for it. Aid in knowing the reading grade placement of each can be obtained from your counselor's office. Posted in the life science room is a list of books in our field that are available in the school library, in the nearest public branch library and in the main library. These are listed according to vocabulary difficulty. We also post a list of the bulletins that are available in our own library.

Below is a copy of the form made in our print shop, and used for keeping a record of each piece of reading done by each student.

Student's name ..... Grade.....
Subject and period .....

Record of Scientific Reading

Author .....
Title .....
Date of publication .....
No. of pages read .....
What you think of the book, article, or pamphlet and why:

These may be kept in an envelope pasted in the note book until called for; or filed in a drawer or box as the teacher desires.

In order to acquaint the students with our science requirements we give each one a copy of the following "special requirements for life science" to place in his notebook for reference. One is also posted in the room.

SPECIAL REQUIREMENTS FOR LIFE SCIENCE

I. Become familiar with the library and its offerings in the field of life science.

1. Consult the mimeographed sheet entitled, "Classification of Life Science Books in the Library."
2. Consult the posted list of books in the room entitled, "Books for Life Sicence."
3. Consult the posted list entitled, "Life Science Pamphlets."

II. Read books, magazines, and pamphlets pertaining to the subject being discussed. Keep a record of each on the blank entitled, "Record of Scientific Reading," that you will get from your science teacher.

III. Keep a vocabulary page in your note book upon which you will record the words that are new to you. Select the words from those that arise during discussion periods, and from any reading that you may do for science. Use each word correctly in a sentence.

IV. Take trips during the semester to any of the places listed on the mimeographed sheet entitled, "Places to Visit for Life Science," or to any additional place that may be so signified by your teacher. Keep a record of each on the blank entitled, "Record of Scientific Visits and Lectures Attended."

V. Attend Life Science lectures or listen to scientific radio lectures. Keep a record of each on the blank entitled, "Record of Scientific Visits and Lectures Attended."

VI. Make a special study of a vital life science topic, and develop a practical project that is correlated with it.

Many of our students come from a semi-industrial district where homes have little available yard space or none at all. In order that they may get some practical agricultural experiences each life science class works for a given amount of time in the field under the direction of the agriculture instructor

and the supervision of the class instructor. Here they get instruction and practice where possible in home beautification, in soil preparation, and care in planting seed, in transplanting, in cutting and arranging flowers for bouquets, in making cuttings, in doing budding, and in doing many other things too numerous to list here. Since home beautification is an aim throughout our entire district, we encourage students to take plants home with them from our agriculture supply.

The aids described above are offered because we find that they do work. We hope that they assist in helping the teaching of life science to become more meaningful to your students.

VIVIAN RAYBOLD PORTER
Jefferson High School
Los Angeles

KEYS FOR MODELS

I should like to pass on the following technique which has been gradually developed by the combined efforts of biology teachers, librarians, and pupils here at Sunset High School.

We type the name of each model and the legend from the manufacturer's key on an unruled 3×5-inch index card and slip it in a library card holder which has been attached with household cement to the under surface of the model. We have found the diagonal card holder preferable to the pocket holder.

We find the keys so placed under the models serve several useful purposes: first, they are convenient and quickly available for pupil use; second, they are out of the pupil's sight when the teacher desires to use the model for a test on mastery of structures; third, they stay with the model; fourth, they are inexpensive and easily replaced when worn; fifth, in case the manufacturer's key is written in a foreign language, one translation by the teacher is sufficient thus avoiding any further discussion over the foreign words.

In order that unnecessary friction on the attached card may be avoided, it is a good practice to elevate the base slightly above the level of the table by inserting four rubber-headed tacks (obtainable at ten cent stores) into the bases of all models which rest flat on the table. The holes for the tacks may be made in plaster of Paris by a rotary motion of any sharp pointed instrument, such as a nail or tack. After the hole has been bored to the proper depth and diameter, place a drop of household cement on the tack and set it in the hole. Although this cement is not absolutely necessary, we use it as an extra precaution. These rubber-headed tacks are a very desirable addition to models having plaster of Paris bases because they aid in absorbing some of the shock incidental to handling.

The manufacturer's key is then filed away with the other laboratory records for reference should the card be lost. However, such a case has never arisen in our laboratory. Each year at inventory time, we make a check on the condition of the cards and replace those which appear too worn or soiled to serve another year.

RUTH MORRIS
Sunset High School,
Dallas, Texas

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Biologist—Why Neglect Speech?

ORA M. JOHNSON
University High School, Los Angeles, California

"A pleasing voice makes listening easy, and whatever tends to make it pleasant for the listener in trying to comprehend what the speaker means is much gained; whatever makes it difficult is so much lost. Consequently, purity of tone and smoothness of voice are fundamental necessities if a speaker desires to carry his thoughts to others on the safest terms."[1]

Every teacher of biology and every prospective teacher should give thought to the preceding quotation. There is nothing more annoying or nerve-wracking when one is trying to comprehend what is being said than to have to strain constantly to understand the speaker because he talks between his teeth with his jaws tight, doesn't move his lips, "swallows" his words at the end of sentences, or his tones are down in his throat. Teachers, otherwise well equipped, but who have high-pitched, shrill, squeaky, thin, flat, monotonous, or inadequate voices are doing violence to the nervous sensibilities of the children who have to listen to them. In this rushing, screaming, screeching age in which we are now living, it is essential to the nervous system to eliminate all unnecessary disagreeable and discordant sounds.

Knowledge of subject matter is not enough to make one an effective teacher. I teach in a Los Angeles city high school that is a training school for future teachers. There are semesters when there are more student teachers than there are faculty members. It is appalling how many of these young people there are who expect to enter the teaching profession that are handicapped in their practice teaching because of inadequacy to make effective use of speech skills and the lack of training in personality development. Many times have the training teachers on the faculty come to me for suggestions for their student teachers whom they were about to fail because of their inability to "put over" their material to their classes. One student teacher in biology took private lessons from me for a semester in order that her training teacher could give her a passing mark. She had never been taught how to project her voice, or to pronounce her words clearly and distinctly, so that she could be heard and understood. She had never been made to realize that without enthusiasm her personality was colorless. She had never had any training that gave her self-assurance and poise. After she had been working with me for a couple of months her training teacher said that she had completely changed from a decidedly negative person to a positive one.

This semester an English teacher, a domestic science teacher, and a biology teacher came to me for suggestions for their student teachers who needed help in presenting their content-material. In many instances the difficulty is merely a personality problem arising from giving wrong impressions by lack of confidence, self-assurance, poise, and the ability to meet people easily and graciously.

Every prospective teacher should be required to have some voice and speech training. In these classes negative personality traits are made positive. Mannerisms that seem a trifling thing are

[1] Woolbert, C. H., *The Fundamentals of Speech*, p. 139.

observed and corrected before they become fixed annoying habits. I think of speech training as including four elements—Body (visual appeal—general effectiveness, which includes personal appearance, posture—walking, sitting, standing, control of body, free from mannerisms, effective use of body, physical and mental poise), Voice, Language, and Thought. Each element of course has many sub-divisions, all of which are necessary for that elusive thing called personality, which is so valuable to a teacher.

One of the very first things that a teacher has to do to establish himself is to inspire confidence in his pupils. When he makes his first appearance before his class, they "look him over" and it is very important to his success that he be at ease. If he has had practice in appearing before groups, he will have an air of self-assurance that will gain respect for him from his pupils.

Teacher training institutions place their stress upon so-called content courses, but fail pitifully to equip their graduates with the necessary skills with which to convey their knowledge to others. "It is fatal to the highest success to have command of a noble language and to have nothing to say; it is equally fatal to have noble thoughts and to lack the power of giving them expression. . . ."[2] Hundreds of future teachers are graduated who lack the power, influence, and personality that a pleasing voice and distinct speech affords. Everyone should be interested in the care and correct use of the vocal instrument, most delicate and precious of all instruments. Proper use of the voice means conservation of energy, greater power and effectiveness in practically all human relationships. Speech specialists at Columbia University say that personality and character traits can be changed by changing voice habits.

Those in charge of teacher training schools should not ignore the facts that speech is a medium through which personality is developed; that speech is an aid to intelligence; that speech is a "social integrator"; that through speech leadership is developed. Every candidate for the teaching profession should be equipped not only with knowledge, but also with the tools with which to make use of that knowledge and to make satisfactory physical, mental, and social adjustments. "Whatsoever may be done toward the improvement of the speech of the prospective teacher is done for the childhood of America that his teacher may not be a pedagogue but in reality the interpreter of life and of literature, for interpretation is the main spring of all instruction whatever the nature of the subject matter."[3]

[2] Mabie, Hamilton Wright, *Essays in Work and Culture.*

[3] McCarthy, Margaret M., *Quarterly Journal of Speech*, April, 1929.

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A Dependable Remedy for the Poison Ivy Group

JAMES B. McNAIR
Los Angeles, California

Although many substances have been suggested as remedies for poison oak (*Rhus diversiloba* T. and G.) and poison ivy (*Rhus Toxicodendron* L.), there is one above all others which because of the uniqueness of its discovery, the scientific proof of its action, and the abundant evidence for its efficacy should be of special interest to all sufferers from these plants.

When the plant poison was obtained appreciably free from contamination it was found to consist of carbon, hydrogen and oxygen. The oxygen was found to be in the hydroxyl groups and not in carbonyl or carboxyl groups. Because of the presence of hydroxyl groups it was thought the principal constituent of the poison might contain a phenol group. The poison of poison ivy and poison oak were found to give similar chemical tests (McNair 1923, p. 86). One of the tests for the presence of a phenol group consists of the addition of iron (ferric) chloride to a highly dilute alcoholic solution of the substance. If the phenol group is present the solution first turns green. Upon the further addition of sodium carbonate the green solution turns red.

Upon the addition of more ferric chloride to the alcoholic solution of the poison the green solution turned black and finally a black precipitate was formed (McNair 1921, 1923). When this solution as well as the black precipitate were placed on the skin of a person highly susceptible to poison oak no symptoms of poisoning occurred.

The use of iron chloride to the extent of five per cent in a half and half mixture of alcohol and water is recommended as a remedy.

If the hands and face are bathed freely in this solution either before or immediately after one goes into a region known to contain poison ivy or its kindred plants, no ill effects need be expected.

In order to eliminate the "personal equation" in regard to this remedy, the following experiences are given of Captain Fred C. Mills of the Boy Scouts of America and Major Thomas R. Marshall, U. S. Army Medical Corps, Retired.

"Last spring when I found I had been affected on the hands by ivy, I gave them an extra heavy dose of ferric chloride solution all over, went out and pulled up a bunch of poison ivy, broke it up and rubbed it thoroughly over both hands. Nothing happened. So, as far as I am concerned it is quite evident that this solution . . . is successful. I have used it a great deal on other people, and am delighted with its effectiveness." (Captain Fred C. Mills.)

"The undersigned has for years used tincture of ferric chloride (standard solution), by local application, both as a preventative and cure, in *Rhus Toxicodendron* poisoning, with uniform success. In his experience the treatment is specific, and should be used in all stages of the eruption; however, the earlier the better. While stationed at Fort Barrancas, Florida; Fort Scriven, Georgia; Fort Bragg, North Carolina; Camp Dix, New Jersey, and Fort Schuyler, New

WHY ABSTRACTS?

A good abstract:

"(1) enables the reader to determine whether or not a paper is of sufficient interest to him to warrant his reading it;

(2) it enables the teacher and general reader to keep themselves informed on the trend of current biological investigations with a minimum of effort; and

(3) it enables any reader to peruse the article more intelligently than he could otherwise."

(Smith, R. C., Jour. Ec. Ent. 31 (5): 564. N 11, 1938.)

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York, many cases of *Rhus Toxicondendron* poisoning were encountered among troops, and the treatment as indicated above was invariably used, to the exclusion of all others. The only possible objection to its use is the discoloration of the skin. However, this is infinitesimal compared to the unsightliness of the eruption, the accompanying discomfort, and the temporary disability in some cases." (Major Thomas R. Marshall.)

LITERATURE CITED

McNair, J. B. "Lobinol—A Dermatitant from *Rhus diversiloba* (Poison Oak)." J. Amer. Chem. Soc., 43: 159–64. 1921.

———. "Rhus Dermatitis, Its Pathology and Chemotherapy." University of Chicago Press. 1923.

———. "Poison Ivy." Botanical Leaflet No. 12, Field Museum of Natural History, Chicago. 1926.

RECENT BOOKS OF INTEREST TO BIOLOGY TEACHERS

A Learning Guide in Biology. DOWNING and MCATEE. Lyons and Carnahan Co. 69¢

Problem Solving in Biology. DOWNING and MCATEE. Lyons and Carnahan Co. 60¢

Activities for Dynamic Biology. BAKER and MILLS. Rand McNally Co. 68¢

Achievement Tests for Dynamic Biology. 14 Pads of Tests. Rand McNally Co. 40¢

Dynamic Biology. BAKER and MILLS. Rand McNally Co. $1.35

The Human Organism and the World of Life. CLARENCE W. YOUNG, G. LEDYARD STEBBINS, CLARENCE J. HYLANDER. Harper and Brothers. 656 Pages.

Biology Demonstration and Assignment Book. E. E. SNYDER and J. J. DUDLESTON. L. W. Singer Co. 52¢

Biological Briefs

ALLEN, W. E. *Cutthroat Competition in the Sea.* Scientific Monthly 49: 111–119. August, 1939.

Many predators engage in strenuous competition to feed on the schools of sardines in California waters; yet sardines survive. Perhaps such ravages on sardine number reduce the amount of intraspecific competition for food. Inshore, where sedentary organisms seasonally release immense numbers of reproductive cells in tide-pools, competition among the young in finding places on which to settle is very strong. Good examples of these are barnacles, which even settle down on each other and crowd out their neighbors in the struggle for space, oxygen, and food. In some colonies, serpulid worms kill off the barnacles by rapid multiplication which results in suffocating or starving the previous residents. Bryozoans may similarly kill barnacles. Mussels likewise compete with one another for space on piers and rocks between mean high- and low-tide lines. Such struggles result in the survival of the strongest. Large colonies of sedentary marine forms attract predators, such as starfish, which also serve to relieve competition. Active rivalry is thus one of the most important and common of natural phenomena.

WELLS, W. F., M. W. WELLS, and STUART MUDD. *Infection of Air.* American Journal of Public Health 29: 863–879. August, 1939.

The article reports on the effectiveness of a new means of disinfecting air for hospitals and all other structures where freedom from the danger of air-borne disease is necessary. It consists of passing air through a curtain of ultra-violet light. Studies of the extent to which diseases may be carried by air have also been made. The contagion of infectious diseases among children is often directly proportional to the amount of confinement in poorly ventilated quarters. Air-borne infection has been fairly well established in measles, psittacosis, dog distemper, tuberculosis, pneumonic plague, influenza, and poliomyelitis.

HEINEMAN, PAUL G. *Friendly Bacteria.* Hygeia 17: 792–794, 853. September, 1939.

In spite of the existence of many types of harmful bacteria against which medical science does battle, in reality human life depends on a far greater host of helpful kinds. Even pathogenic bacteria are cultivated for the production of antitoxins and vaccines. In foods, bacteria are responsible for turning alcohol into vinegar, giving butter and cheeses their flavor, and producing buttermilk. Nitrogen-fixing bacteria provide soil nitrates. Bacteria of decay are of immense value in returning minerals to the soil. Such decaying material is of greatest value as plant fertilizer when lime has been added to neutralize soil acids, and when oxygen has been provided through plowing. Other types of bacteria serve to purify sewage and waste-polluted streams. In industry, pure cultures of bacteria and yeasts are now being used extensively.

MELLANBY, KENNETH. *The Functions of Insect Blood.* Biological Reviews, Cambridge Philosophical Society 14: 243–260. July, 1939.

Insects have no closed circulatory system; the blood circulates around the body tissues propelled by an open, pulsating dorsal tube in most species. The blood makes from 15% to 70% of the body

weight. The blood cells are not respiratory, but phagocytic in function. They ingest muscle tissue at the inception of the pupal stage, dead tissue during each moult, and invading bacteria and protozoa. The blood plasma has among its functions the following: water storage; transportation of digested food; occasional food storage; respiration, subsidiary to the tracheal system; protection against predators through reflex bleeding of distasteful plasma; immunity against microörganisms; and mechanical pressure for emergence of the insect from egg, moulted exoskeleton, and pupal case. Clotting, when exhibited at all, appears so slow as to be of no apparent protective value.

KANSAS ASSOCIATION OF BIOLOGY TEACHERS

The Kansas Association of Biology Teachers in their annual meeting at Topeka on November 3, elected the following officers for the coming year:

President—Dr. J. A. Trent, K.S.T.C., Pittsburg.

President-elect—Dr. John Breukelman, K.S.T.C., Emporia.

Vice-Pres.—Mr. Ira Hassler, Chapman.

Sec.-Treas.—Miss Gladys Beck, Kansas City.

Dr. D. F. Miller, of the Ohio State University, addressed the Association on "The Uses of Materials in the Teaching of the Biological Sciences." Dr. Breukelman discussed "The Aquarium as a Teaching Device," and Miss Frances Hutchinson discussed "Practical Biology" at the meeting. Dr. Dellinger, the retiring president, addressed the group on "The History of the Kansas Unit, and of The National Association."

The Kansas Association is cooperating with the State Department of Education in the preparation of a Course of Study for high school biology for the State of Kansas. A committee was also appointed to assist the Advisory Committee of the State Textbook Commission in the selection of a suitable textbook for the high schools of the State.

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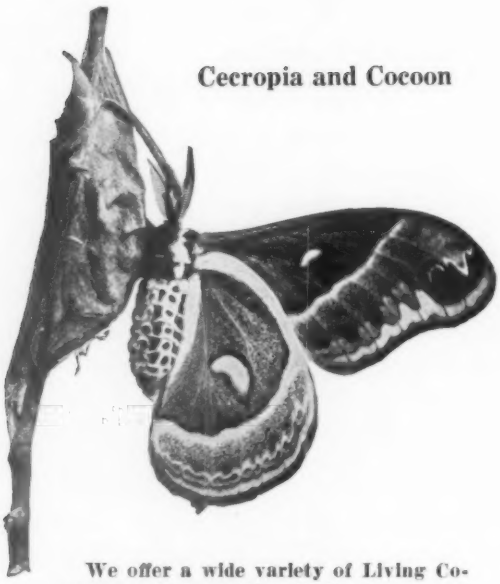

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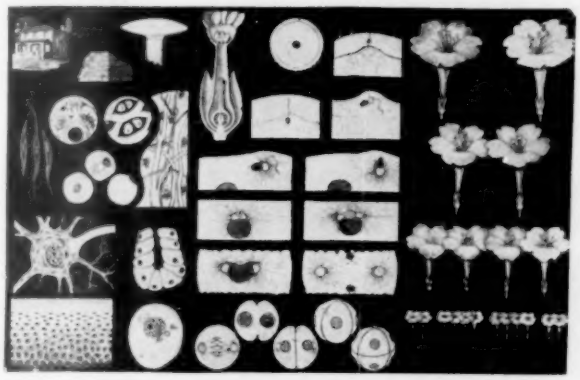

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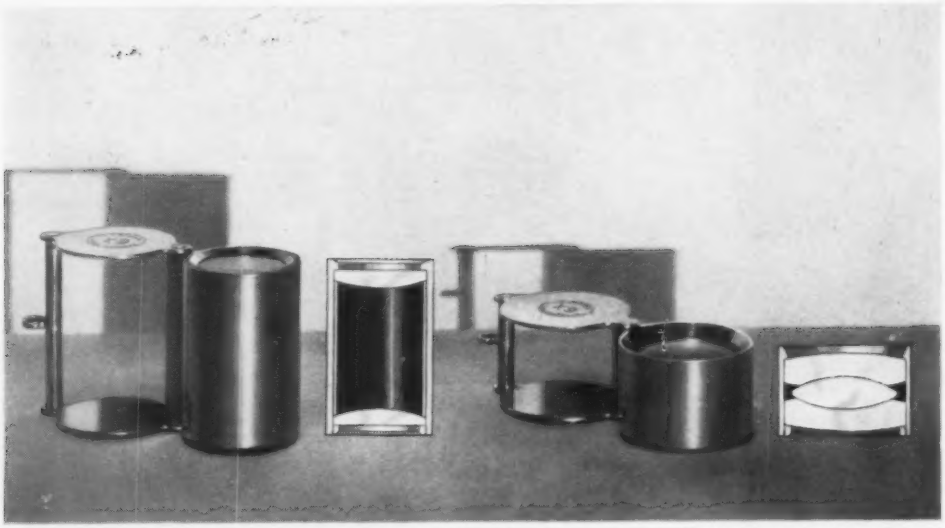

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